TITLE	FUNCTIONAL THERMAL CYCLING TEST ON AMICA ELECTRONICS
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1. INTRODUCTION

This document describes the functional electric tests performed on the camera of AMICA during the Environmental Test of Thermal vacuum cycling, carried out in Terni from 14th to 19th/03/2006 and is an integral part of following documents which explain the procedural aspects of the test:

1) Environmental Test Report: **Star Tracker Thermal Vacuum Cycling Test**, date: 06/07/06, rev: A01, prepared by : ing. Serena Borsini (file: ASTCFuncThCycling),

2) **Star_Tracker_TV_test_Plan__050106**, APPENDIX_1_rev2,

The description which follows up is therefore to be seen as a separate section of a same report and all the references to the above mentioned documents maintain the same name.

The documentation of the test functionality is made up of two parts:

1) **Table of the current flow absorbed** during the 8 cycles of the test, to prove that the equipment has not suffered from catastrophically bad functioning during the test and that the absorbtion values are repetitive and characteristic in every environmental condition.

2) **Images of the CCD** which are those taken during the different phases of the test. For practical reasons the images shown are all those taken during the first cycle, mentioned in the Test Plan, and those taken during the last cycle, to prove that the functioning of the camera, although influenced by the environmental temperature, has always shown to be according to the aim of the project and that the camera reacts to the re-establishment of the environmental conditions returning to its initial response.

To evaluate the image quality of the camera it should be noticed that the CCD set up on board during this test is the same one that had previuosly been bombarded with heavy ions to a level by almost one order of magnitude higher than the level foreseen on board the ISS at SIRAD-INFN in Legnaro. The CCD consequently underwent an annealing process at 200°C to reduce as much as possible the thermic background noise caused by the bombardment.
The use of this CCD for the Thermal vacuum cycling test was decided to prove its capacity to support both the stress due to the bombardment and the stress due to extreme temperature cycles. As a consequence the images taken by the camera during the test show a level of background noise in the form of granulosity of the image, especially at high temperature, which is by some orders of magnitude higher than that of the CCD which is going to be installed on AMICA. This noise is an exponential function of the temperature: with rising temperature it becomes the factor that sets a limit to the use of

the CCD, while with diminishing temperature it can be ignored compared to the electronic noise.
In some of the images shown there are some lighter spots which cluster together or line up. They are due to a sampling problem of the signal receiving section, outside of the vacuum chamber, that in the case of certain pixel values adds the constant value of 256 (out of 4095) to them: decoding error on 8^{th} bit. This explains why the white spots are seen only in certain images.

2. THERMAL VACUUM CYCLING CURRENTS

PHASE	DAY	TIME	I(+12V) (mA)	I(-12V) (mA)	I(+3.3V) (mA)
setup					
	14	22.18	187	69	56
	14	22.37	184	66	56
1st cycle					
hot op.	16	0.03	195	72	54
cold op.	16	12.32	126	63	97
cold best	16	15.16	140	60	63
2nd cycle					
hot best1	16	17.41	195	68	57
hot op.	16	23.00	195	72	54
hot best2	17	2.06	195	68	54
cold best1	17	6.00	166	67	61
cold op.	17	10.41	195	68	61
cold best2	17	13.41	200	68	59
3rd cycle					
hot best1	17	18.02	204	66	59
hot op.	17	21.25	212	71	59
hot best2	18	0.33	204	63	54
cold best1	18	5.38	200	68	60
cold op.	18	8.44	198	70	66
cold best2	18	11.42	202	70	61
4th cycle					
hot best1	18	15.43	205	65	56
hot op.	18	19.33	214	72	56
hot best2	18	22.39	206	66	56
cold best1	19	3.34	200	67	61
cold op.	19	7.25	195	67	97
cold best2	19	10.26	202	69	61
5th cycle					
hot best1	19	14.33	207	68	56
hot op.	19	18.10	215	74	57
hot best2	19	21.13	207	68	56
cold best1	20	2.20	203	69	61

cold op.	20	5.03	195	67	97
cold best2	20	8.13	203	69	61

6th cycle

hot best1	20	12.33	208	68	56
hot op.	20	16.46	215	74	57
hot best2	20	19.50	208	68	56
cold best1	21	0.35	207	69	61
cold op.	21	3.57	199	70	98
cold best2	21	7.01	202	69	61

7th cycle

hot best1	21	13.13	207	68	56
hot op.	21	17.15	215	74	56
hot best2	21	20.54	207	68	56
cold best1	22	2.07	203	69	61
cold op.	22	4.50	198	69	96
cold best2	22	8.56	203	69	61

8th cycle

hot op.	22	18.05	212	72	56
hot best	22	21.11	207	68	56
cold op.	23	7.00	193	67	94
cold best	23	10.22	202	69	61

return to ambient

	23	14.10	203	65	55

3. CCD IMAGES

Below the CCD images taken both during the complete first cycle and the last cycle are reported. The first one is the most representative for the camera behavior at the extreme tempeture conditions, while the last one points out the camera surviving capability.

When requested by the test plan both a dark image and a bright image are shown. The bright image was taken with a lamp ligting the transparent window of the vacuum chamber. However, because the intensity of the diffused light into the chamber was not strictly controlled, the CCD sensitivity in the different working conditions can not be quantified.

An evaluation of the CCD image quality was carried out through the calculation of the average value and the variance of the CCD pixels intensity, inside a central 100x100 pixels area. Both values are reported at the side of the image as m and σ.

The names of the images follow those mentioned in the test plan.

Every image shown in the following text is obtained by adjusting contrast and luminosity at its best so as to make it suitable for printing.

ELECTRONICS SETUP

IMAGE: DARK_23_00_14_03.png, (m = 325.5, σ = 1.03)

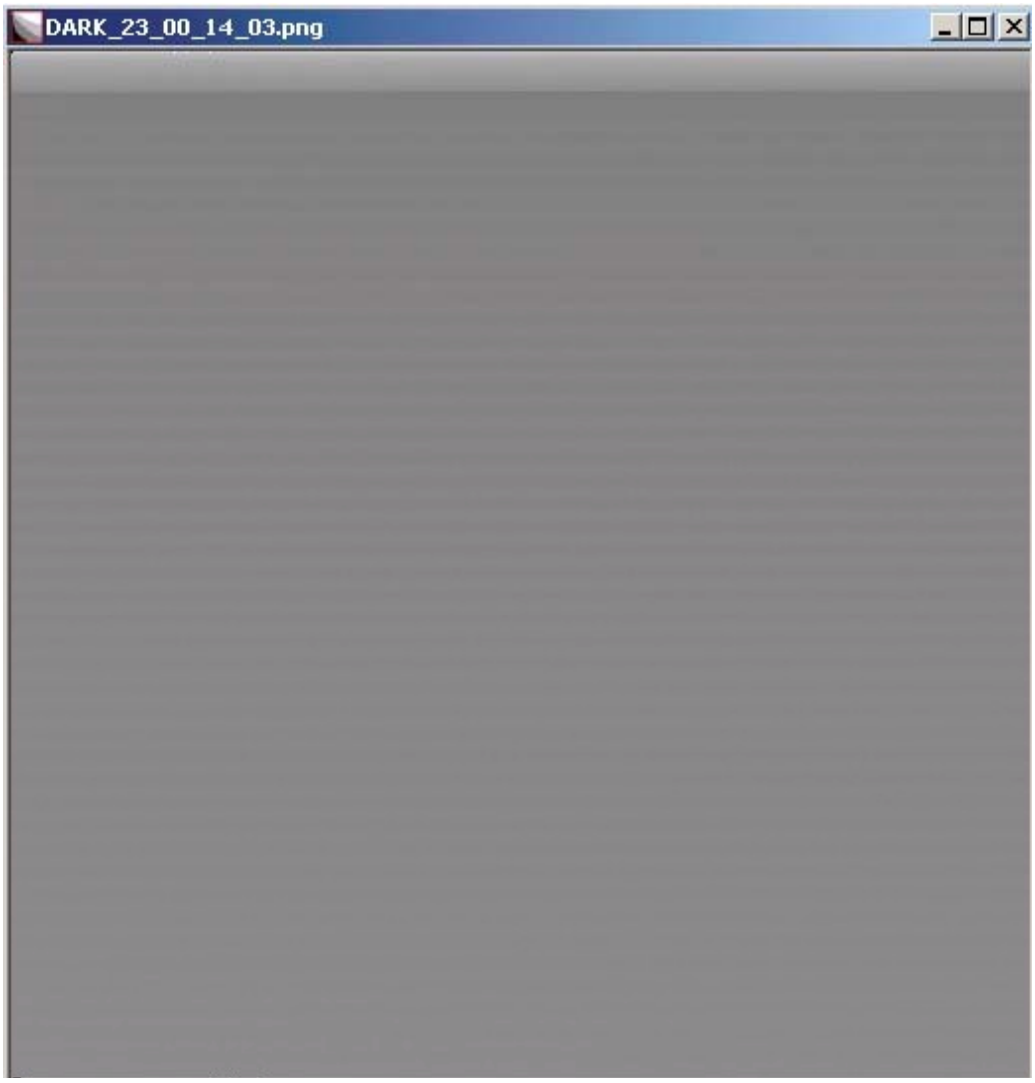
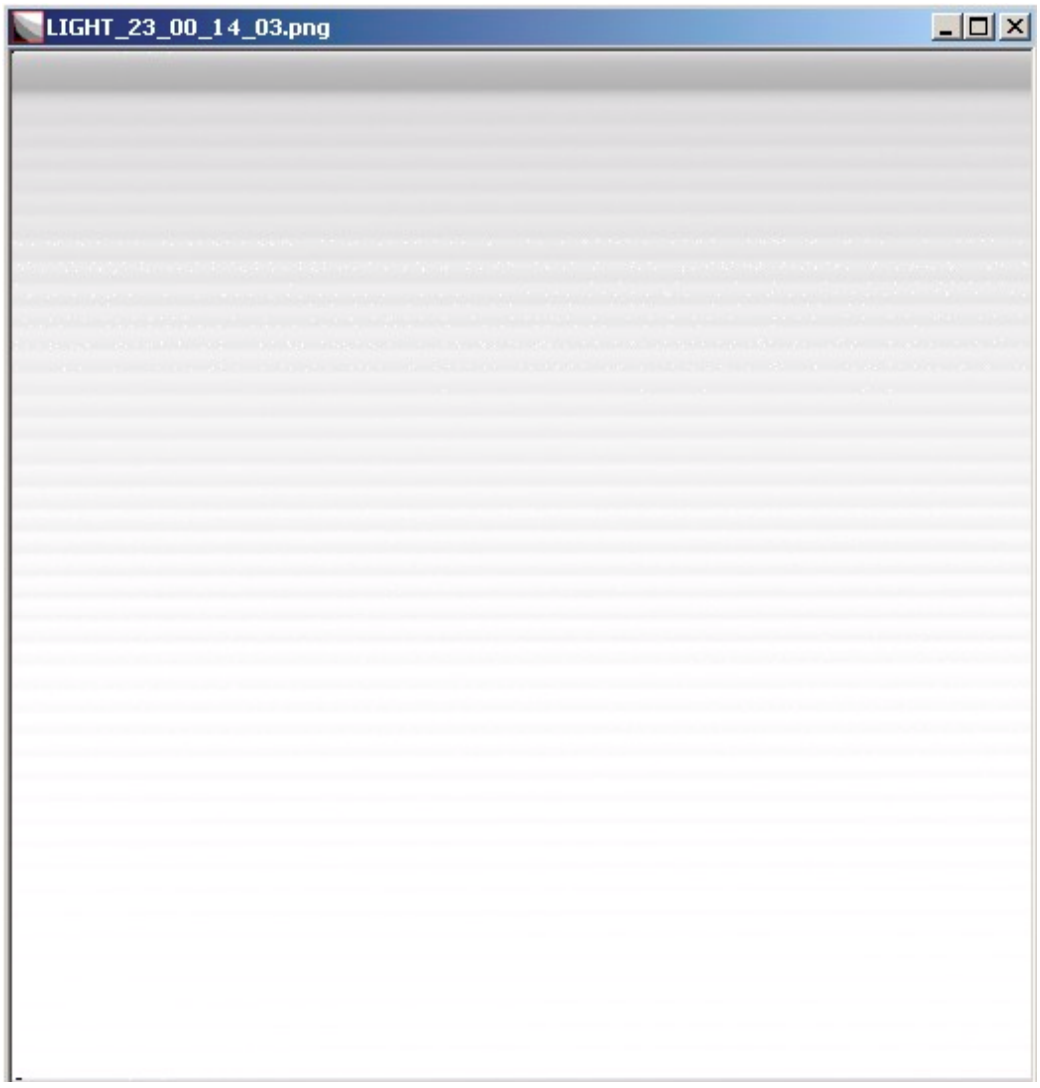
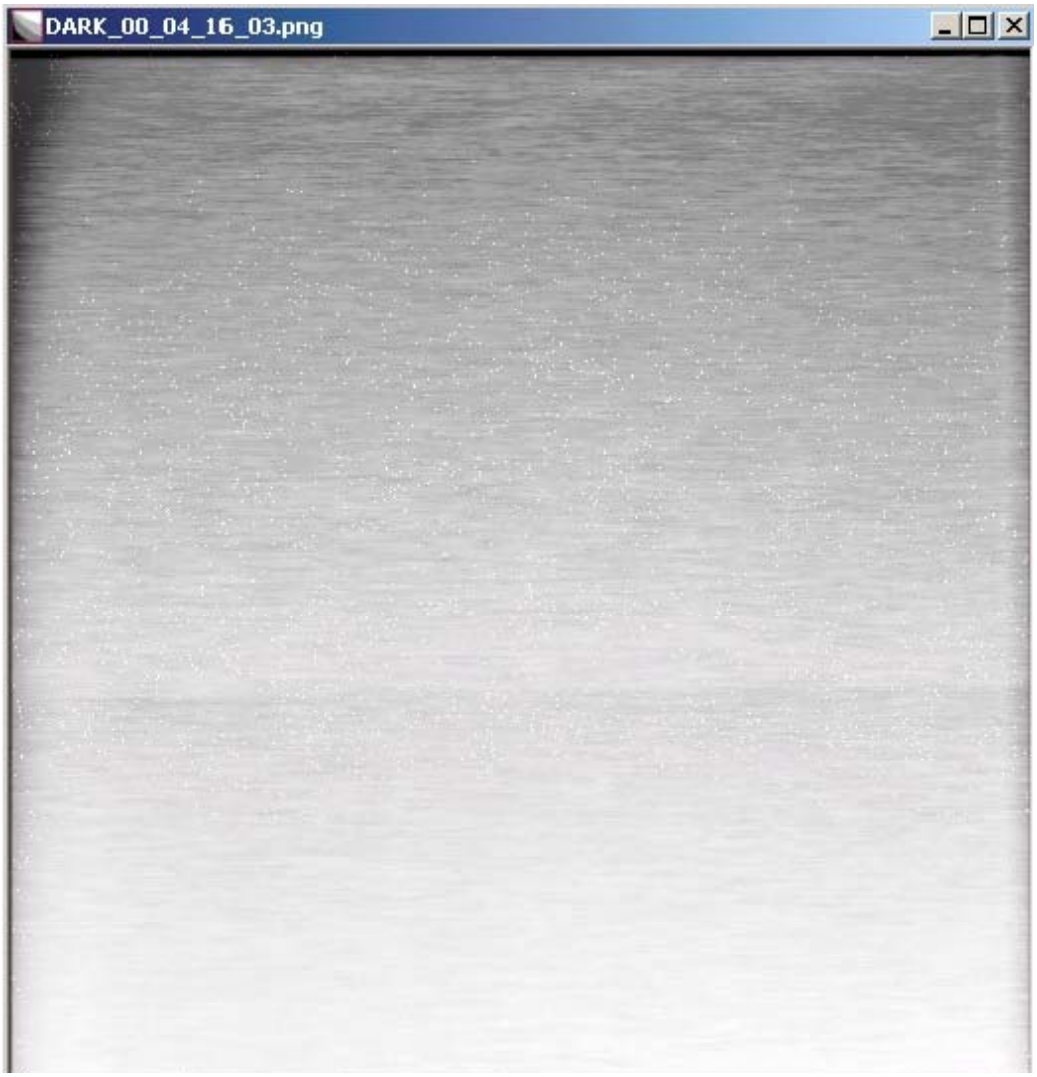


IMAGE: LIGHT_23_00_14_03.png (m = 406.2, σ = 10.2)

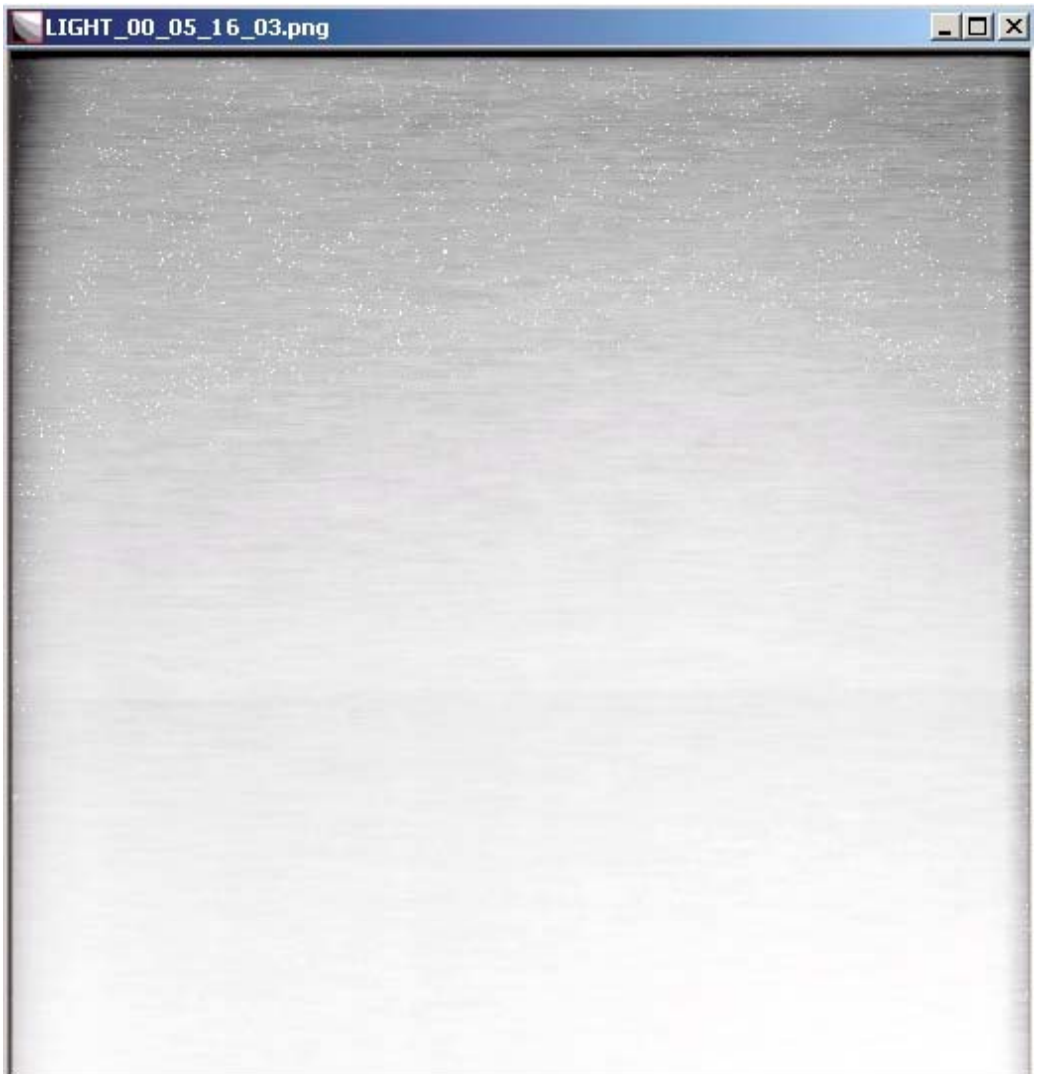


1st cycle: HOT OPERATIONAL FUNCTIONAL TEST CAMERA ON

DARK_00_04_16_03.png (m = 684.5, σ = 20.4)

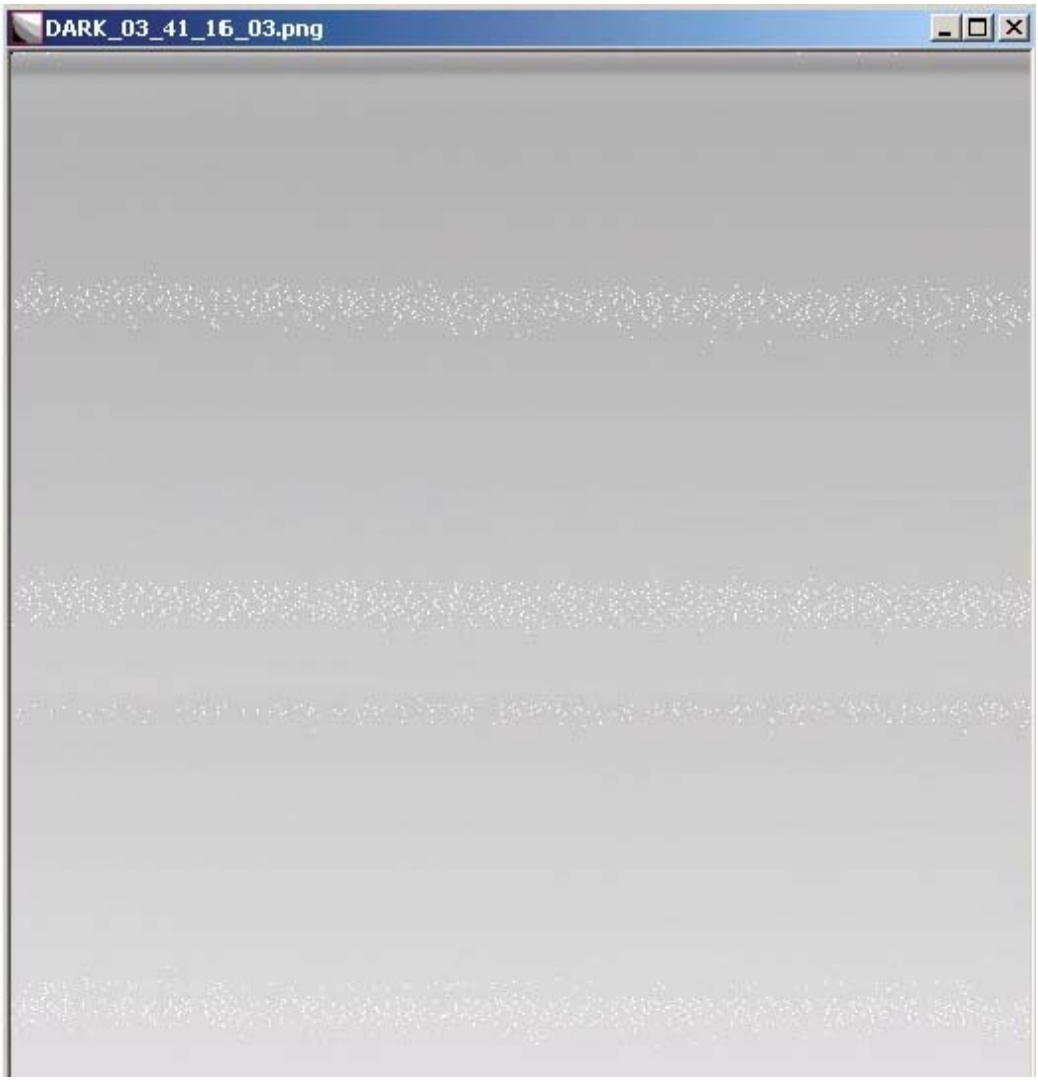


LIGHT_00_05_16_03.png (m = 721.2, σ = 15.0)



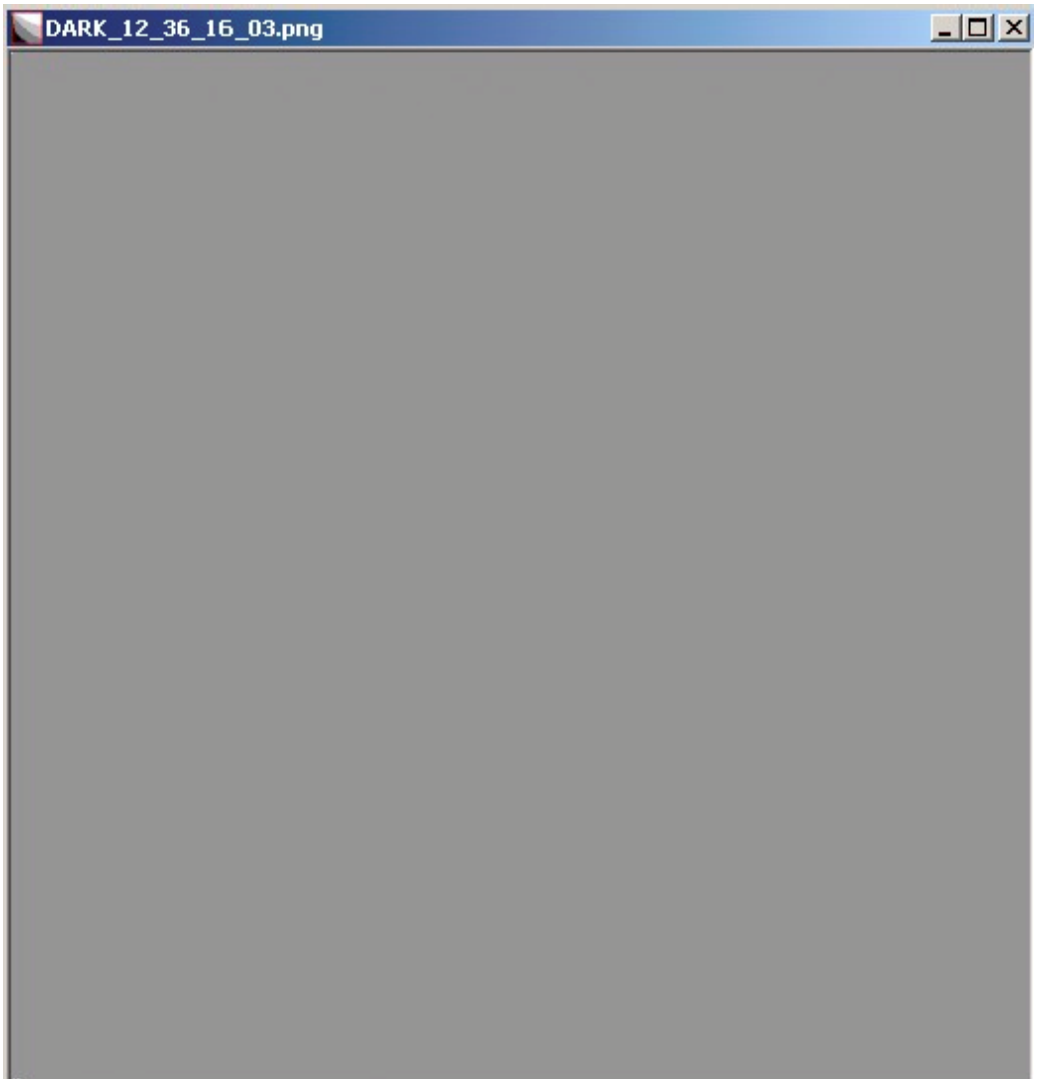
1st cycle: HOT BEST PERFORMANCE

DARK_03_41_16_03.png (m = 405.4, σ = 9.95) ******light_06_03_16_03



1st cycle: COLD OPERATIONAL FUNCTIONAL TEST CAMERA ON

DARK_12_36_16_03.png (m = 1.0, σ = 0.14)



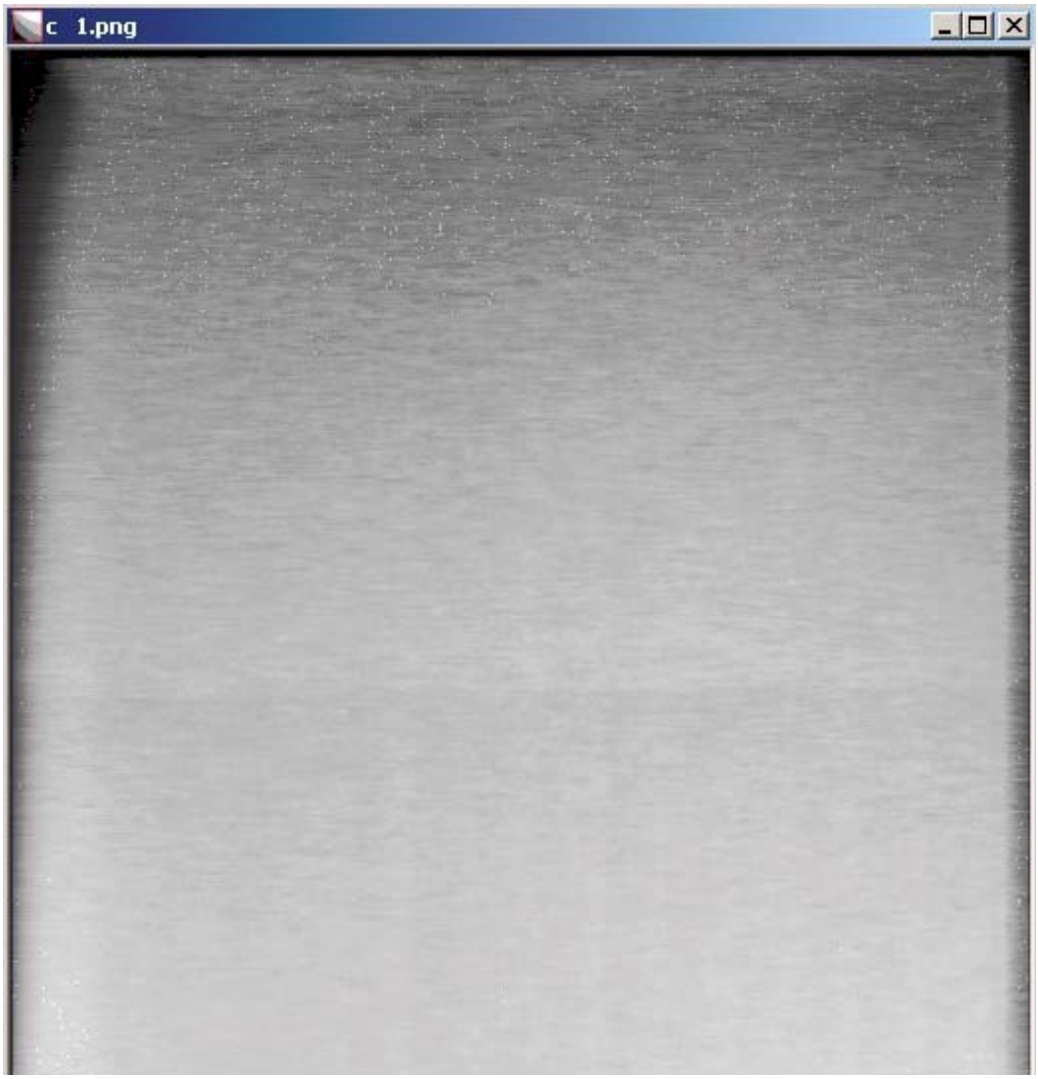
LIGHT_12_40_16_03.png (m = 1.0, σ = 0.2)

1st cycle: COLD BEST PERFORMANCE LIGHT ON

C_31.png (m = 18.0, σ = .19)

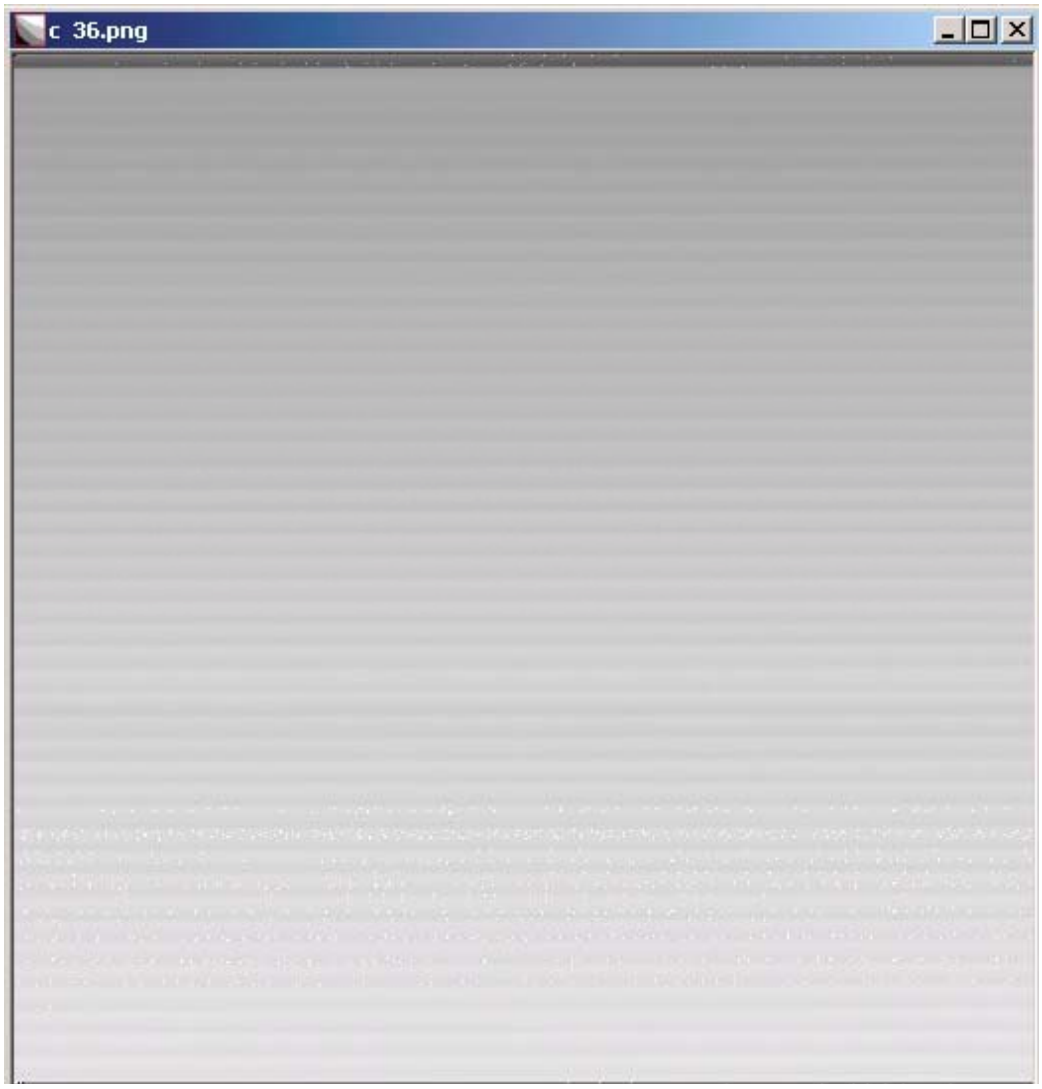
8th cycle: HOT OPERATIONAL FUNTIONAL TEST LIGHT ON

C_1.png (m = 739.7, σ = 17.5)



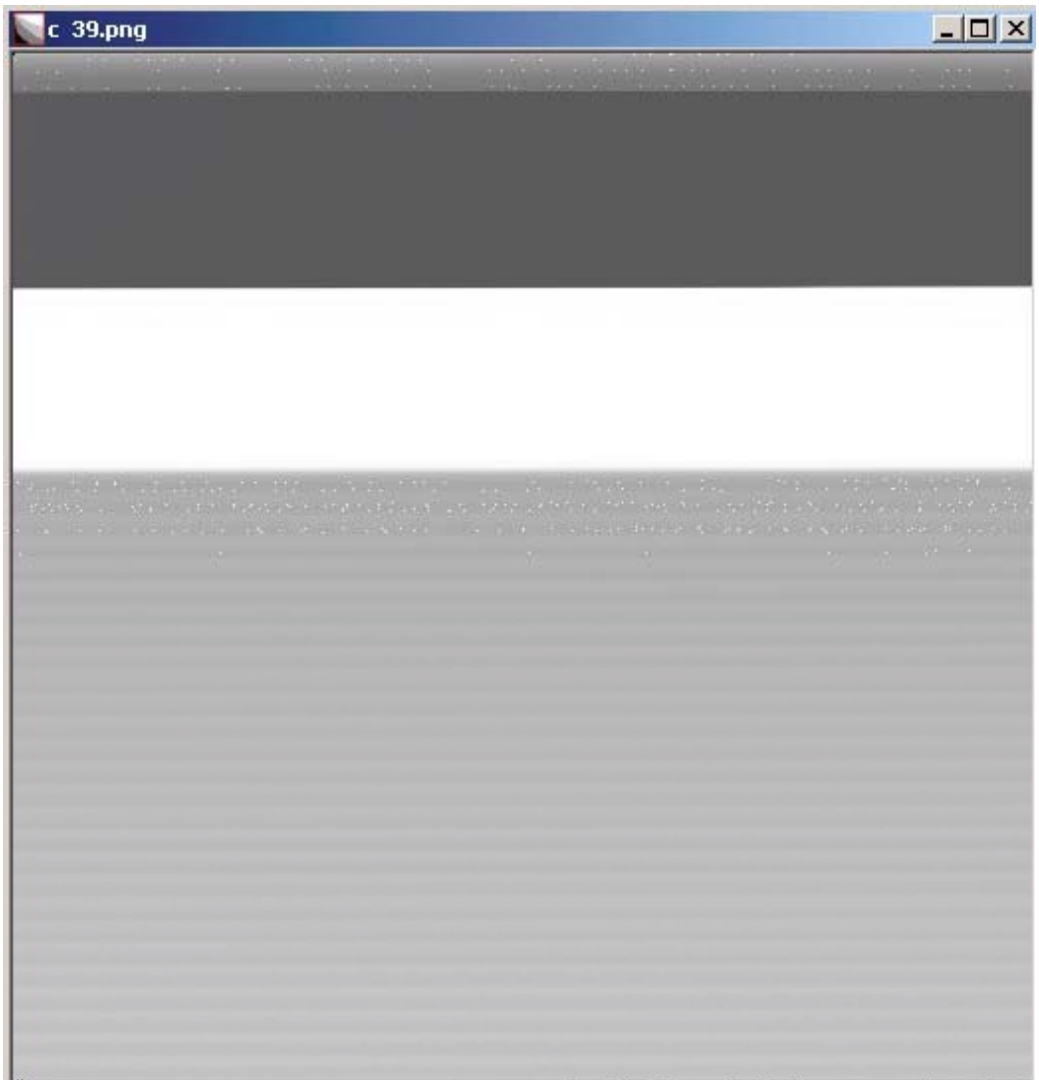
8th cycle: HOT BEST PERFORMANCE LIGHT ON

C_36.png (m = 502.5, σ = 13.05)



8th cycle: COLD BEST PERFORMANCE LIGHT ON

C_39.png (m = 1468.5, σ = 8.18)



8th cycle: AMBIENT

CAMERA1.png